

## Publication

Assessing whether universal coverage with insecticide-treated nets has been achieved: is the right indicator being used?

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Insecticide-treated nets (ITNs) are the primary tool for malaria vector control in sub-Saharan Africa, and have been responsible for an estimated two-thirds of the reduction in the global burden of malaria in recent years. While the ultimate goal is high levels of ITN use to confer protection against infected mosquitoes, it is widely accepted that ITN use must be understood in the context of ITN availability. However, despite nearly a decade of universal coverage campaigns, no country has achieved a measured level of 80% of households owning 1 ITN for 2 people in a national survey. Eighty-six public datasets from 33 countries in sub-Saharan Africa (2005-2017) were used to explore the causes of failure to achieve universal coverage at the household level, understand the relationships between the various ITN indicators, and further define their respective programmatic utility.; The proportion of households owning 1 ITN for 2 people did not exceed 60% at the national level in any survey, except in Uganda's 2014 Malaria Indicator Survey (MIS). At 80% population ITN access, the expected proportion of households with 1 ITN for 2 people is only 60% ( $p = 0.003$  R; 2; = 0.92), because individuals in households with some but not enough ITNs are captured as having access, but the household does not qualify as having 1 ITN for 2 people. Among households with 7-9 people, mean population ITN access was 41.0% (95% CI 36.5-45.6), whereas only 6.2% (95% CI 4.0-8.3) of these same households owned at least 1 ITN for 2 people. On average, 60% of the individual protection measured by the population access indicator is obscured when focus is put on the household "universal coverage" indicator. The practice of limiting households to a maximum number of ITNs in mass campaigns severely restricts the ability of large households to obtain enough ITNs for their entire family.; The two household-level indicators-one representing minimal coverage, the other only 'universal' coverage-provide an incomplete and potentially misleading picture of personal protection and the success of an ITN distribution programme. Under current ITN distribution strategies, the global malaria community cannot expect countries to reach 80% of households owning 1 ITN for 2 people at a national level. When programmes assess the success of ITN distribution activities, population access to ITNs should be considered as the better indicator of "universal coverage," because it is based on people as the unit of analysis.

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